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ECONOMIC AND PRODUCTION IMPLICATIONS OF AN ASSUMED SOVIET GUIDED MISSILE PROGRAM 1954 to 1963

(ORR CONTRIBUTION TO THE AD HOC WORKING GROUP ON NESC REQUIREMENTS)

CIA/RR IP-634

(ORR Project No. 37.2414)

3 September 1958

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FOREWORD

1. The purpose of this contribution is to assist the Ad Hoc Working Group on NESC Requirements in preparing a series of intelligence assumptions requested by the NESC. It presents economic and production implications of the assumed Soviet guided missile stockpile objectives supplied by the Ad Hoc Nuclear Delivery, and Air Defense Working Groups.

2. The paper presents an analysis of the general scope and character of Soviet economic activity required to implement a program of the magnitude and composition assumed. The analysis should be used in conjunction with other information, and in light of the competition for economic resources of other military and non-military programs, to judge whether the USSR is likely to carry out the guided missile program specified.

3. Because of time limitations, this contribution has not been coordinated with the Guided Missiles Intelligence Committee (GMIC), and reflects only the immediate views of the Office of Research and Reports. Its findings, therefore, should be considered preliminary. It is being disseminated in its present form in order to maximize its utility to the Ad Hoc Working Group.

CONTENTS

Appendixes

MAJOR FINDINGS

1. The assumed program is very large and costly. While it is within Soviet gross economic capabilities, it nevertheless, is a program implying extremely high priorities for most of the systems, and a sense of urgency on the part of the USSR to acquire substantial operational capabilities at the earliest possible dates. Some of the systems, in fact, require rates of production and expenditures so large as to very nearly conflict with the following governing assumptions of the over-all study:

> (1) the USSR is not and will not during the period of this estimate be preparing for general war to begin at any particular date in the future; and
>
> (2) all Soviet programs for production and operational deployment of guided missile systems during this period will be governed by considerations of optimum effectiveness vs. cost of weapons systems, maximum utilization of proven military hardware, minimum loss or wastage due to obsolescence factors, and maximum efficiency in the utilization of available resources.

2. The share of projected Soviet military expenditures required by the assumed program would grow to a level of about twenty percent of total expenditures by 1962*. Although the program implies an apparently reasonable share of projected Soviet military expenditures, (see Table 1) the procurement of missile system hardware would represent almost 40 percent of total military hardware procurement by 1960-1961. Missile system procurement in 1960-1961, for example, would almost equal total aircraft and naval vessel procurement combined.

* The estimates of cost used in this analysis include only the costs which are directly incurred in the establishment and operation of the guided missile systems in the assumed program. They do not include the costs of research and development, warheads, the necessary but multi-purpose ground control intercept and early warning radar systems, or the aircraft and naval vessels necessary to carry some of these missiles. They also specifically exclude costs incurred for space flight programs. If these excluded items were taken into account, including the guided missile program's pro rata share of the cost of the multi-purpose items, the portion of Soviet military expenditures attributable to guided missiles would, correspondingly, increase considerably over the twenty percent cited.

TABLE I

Comparison of Total Cost of Assumed Program and Projected Soviet Military Expenditure by Year, 1954-1962
(Billions of 1957 Dollars)

	1954	1955	1956	1957	1958	1959	1960	1961	1962
USSR Military Expenditures	45.3	45.7	44.3	43.2	45.6	50.8	52.3	53.0	56.3
Assumed Program	0.4	0.8	1.1	1.0	2.1	5.5	9.2	10.4	10.8
Assumed Program as Percent of Military Expenditures	0.9	1.7	2.5	2.3	4.6	10.8	17.6	19.6	19.2

3. The total cost of the assumed program is divided almost equally between offensive and defensive missile systems. The high priority accorded the ICBM-IRBM systems is reflected by their accounting for almost one-third of the entire cost of the program. The ICBM program alone would account for almost one-quarter of the total program cost, and it is by far the largest single system in the program.

4. Although the ICBM stockpile requirement of 800 in the assumed program, is higher than the arbitrarily selected 500 ICBM figure used in NIE 11-5-58 as a basis for gauging Soviet capabilities, ICBM production rates in the assumed program are consistent with NIE 11-5-58, representing generally middle values within the ranges given in that estimate.

5. Approximately four-fifths of the 50 billion dollar total cost of the assumed program for 1954-1963 would fall in the last four years of the period. Investment and operating costs for the missile program would rise very sharply from about one billion dollars in 1956-1957 to more than 9 billion in 1960, with expenditures of from 10-11 billion dollars annually thereafter.

6. The extremely high peak production rate (8,500 missiles per month), and magnitude of economic resources (more than six billion dollars in four years), required to achieve the assumed deployment of the SA-3 low altitude defensive missile system by the time specified,

appear inconsistent with the governing assumptions of the study (paragraph 1, above). The Ad Hoc Working Group should review the priority likely to be accorded this program by the USSR in the light of probable Soviet views of Western low altitude attack capabilities, and reach a judgement as to modification, if any, of the SA-3 program as presented. To a lesser degree the same type of finding holds for the SA-2 system where a peak production rate of more than 5,000 missiles per month would be required to meet the stockpile objectives by the time specified.

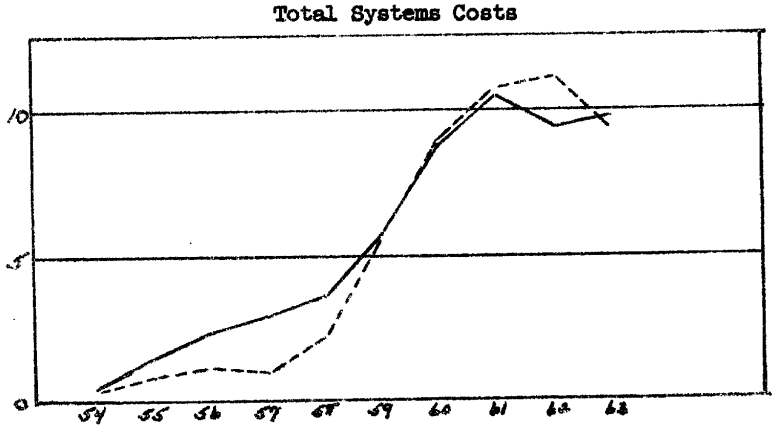
7. The SS-7 (200 n.m.) submarine conversion program appears questionable in the light of the discussion of operational capabilities contained in NIE 11-5-58. The estimate states that by 1958 the USSR would probably have converted only a few conventional submarines to guided missile employment, since the requirement for external stowage imposes rather severe limitations on speed, stability and maneuverability of the launching submarine. As a result, the assumed program shows only three submarines converted by the end of 1958. In the years 1958 through 1961, however in order to meet the stated requirement, this results in a conversion program of an admittedly inferior weapons system concurrently with the new production of superior guided missile submarines with internal stowage. It is suggested that the Ad Hoc Working Group reexamine the SS-7 conversion program requirement in order to determine whether increased new construction of the SS-7 weapon system submarine, which appears to offer a more reasonable solution, is possible.

8. The attention of the Ad Hoc Working Group is called to the production scheduling and cost implications of the 100 n.m. through 750 n.m. range ballistic missiles (SS-1 through SS-4) Although radar track/radio command guidance versions of these missile systems are estimated in NIE 11-5-58 to be available for operational use very early in the period (1954-1956), each is also estimated to be improvable to an all-inertial guidance system by 1959. In order to minimize wastage due to obsolescence factors, the production schedules used in the assumed program for these systems were held at somewhat depressed rates until the all-inertial systems became available. This had two effects: (1) the number of operational missiles available by 1958 was considerably smaller than would have been the case otherwise; and (2) while reducing

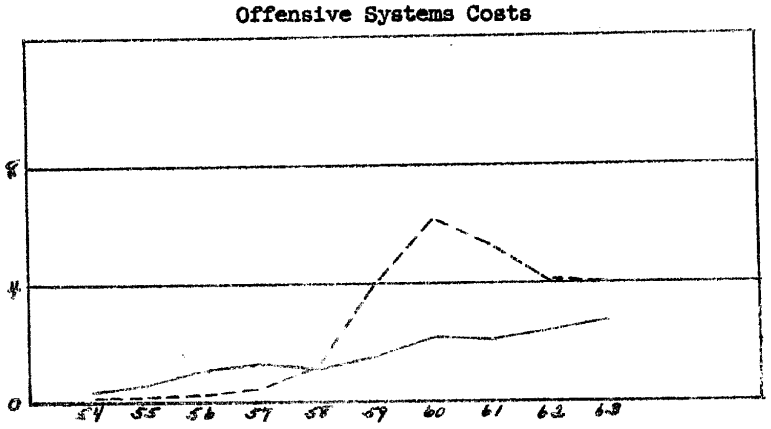
TABLE II

Comparisons of Costs of NIE 11-5-57
and Assumed Program by Year, 1954-1963
(Billions of 1957 Dollars)

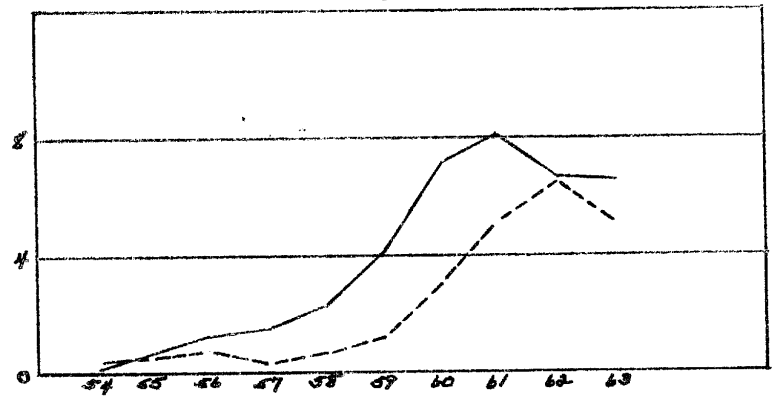
Total Systems Costs



Offensive Systems Costs



Defensive Systems Costs



——— NIE 11-5-57

------ Assumed Programs

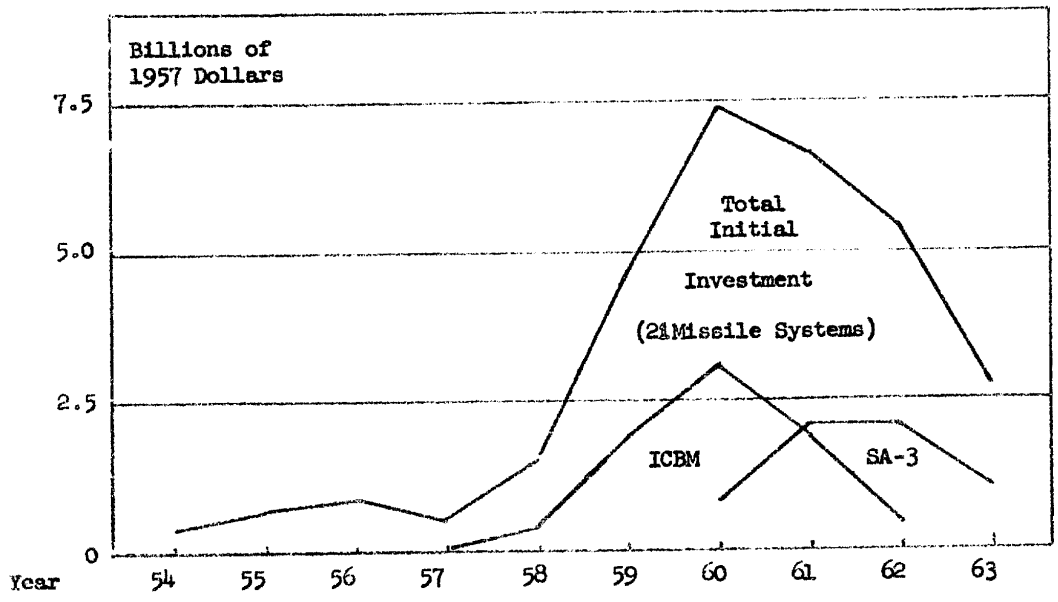
over-all costs, this tended to accentuate slightly the already high costs of the total missile program in the years 1960-1961. The Ad Hoc Working Group should review the relative advantages of the all-inertial systems and judge whether the USSR would be likely to await their availability before acquiring the stockpiles specified.

9. As shown in Table II, the total cost of the assumed program is of the same magnitude as that presented in Annex A of NIE 11-5-57, if prices, and the period covered, are adjusted for comparability. The principal differences in the curves of total costs are that while the assumed program initially builds up more slowly, it then increases more rapidly in the 1958-1960 period, revealing a slightly higher and more even peak than NIE 11-5-57. The internal composition of the costs of the two programs, however, reveal significant differences, as shown on the sub-tables comparing costs of offensive and defensive systems. Whereas offensive missile systems accounted for only thirty percent of the total costs in the NIE, they account for approximately half in the present study. The higher cost of offensive missile systems in the assumed program stems principally from changes in the ICBM and IRBM systems. In the present study, parameters relating to higher rates of fire and reduced vulnerability result in considerably higher costs than the minimum ICBM and IRBM systems included in the NIE. In contrast to the offensive systems, the cost of defensive missile systems in the assumed program represents a sizeable reduction compared to the NIE program.

10. The ICBM and the low altitude surface-to-air systems are clearly the two highest priority systems in the assumed program, with their combined investment costs representing about 45 percent of the total initial investment in the program. (See Table III)

TABLE III

Selected Initial Investment Costs of Assumed Program by Year, 1954-1963



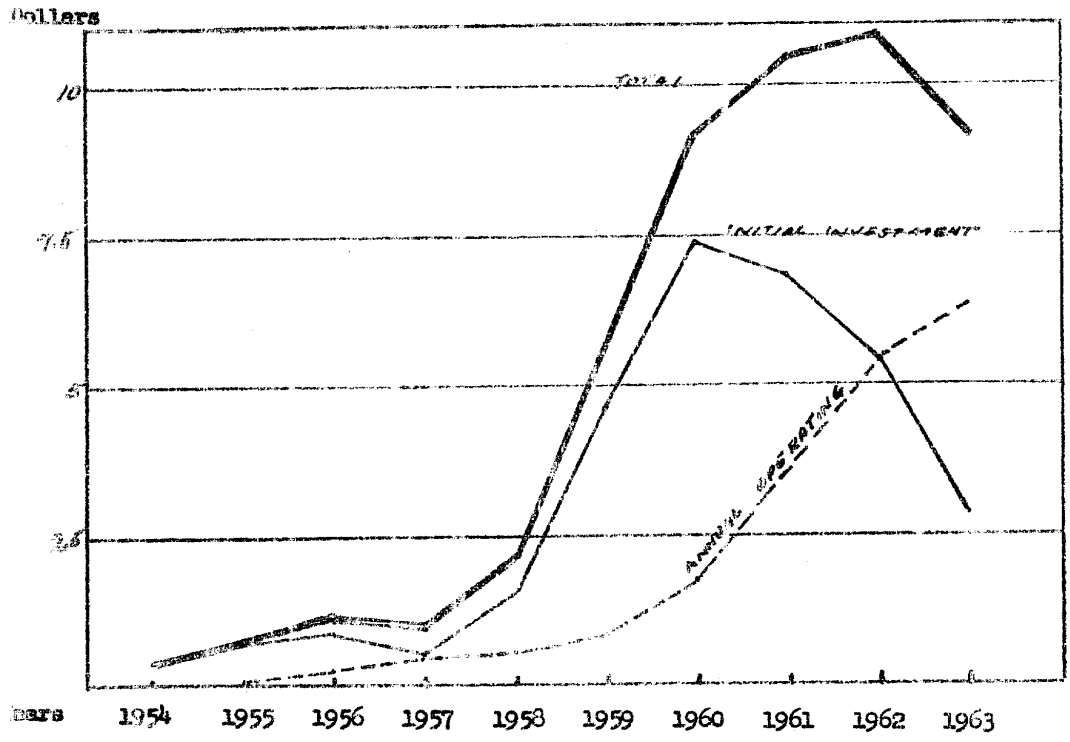
DISCUSSION AND SUPPLEMENTARY DATA

Total Program Costs

1. Table IV shows the level of expenditures for initial investment and operating costs* in the assumed program, by year, as well as total costs.

Table IV

Yearly Cost of the Assumed Program, 1954-1963
(Billions of 1957 Dollars)



* See Appendix A for detailed statistical tables relating to the Assumed Program.

** In calculating the costs of the assumed program a clear distinction has been made between two basic types of costs: initial investment cost, and annual operating cost. Initial investment costs are those one time costs involved in establishing and activating the system. Annual operating costs are the additional recurring expenses which result from the operation and maintenance of equipment and personnel initially procured and paid for under investment costs.

2. As shown in Table IV, the total cost of the program increases very sharply from 1958 to 1960, with costs in 1960 being more than four times 1958. This sharp rise is caused in part by the fact that eight new Soviet missile systems are estimated to become initially available for operational use during this three-year period, with a resultant heavy increase in the costs required to produce and deploy these systems in quantity. The implied rate of increase in the total cost of the missile program, however, is somewhat misleading unless it is remembered that the cost of research and development has not been included. It is clear from the large number of systems which become available in this compressed time period, that the costs of development incurred in the years immediately preceding would be quite large, and could be as high as several billion dollars per year. While developmental costs would continue throughout the period, they would decline sharply as a percentage of total Soviet guided missile program costs compared to the earlier period.

3. Table V presents a summary of the total costs of the assumed missile program by category of missiles.

Table V

Total Costs of Assumed Missile Program
By Category of Missiles
(Billions of 1957 Dollars)

	Initial Investment	Operating Costs	Total	Percent of Total
Surface-to-Air, Ground-Launched	12.3	6.4	18.7	37.0
Surface-to-Air, Ship-Launched	1.2	.3	1.5	3.0
Air-to-Air	2.4	1.7	4.1	8.3
Air-to-Surface	.2	.2	.4	.8
Surface-to-Surface, (up to and including 700 n.m.)	3.8	4.5	8.3	16.4
Surface-to-Surface, Submarine-Launched	1.4	.2	1.6	3.2
IRBM (1,100 n.m.)	2.0	1.6	3.6	7.1
ICBM (5,500 n.m.)	7.9	4.3	12.2	24.2
TOTAL	31.2	19.3	50.5	100.0

4. Although variations in total cost between missile systems in Table V generally reflects the higher costs of those systems, it also results from other factors such as size of stockpile, number of years operational, and system elements costed. In the latter instance, for example, the costs of systems such as the Air-to-Air, Air-to-Surface, Naval Launched, Surface-to-Air, and part of the Surface-to-Surface Naval, understate true total costs somewhat, in that they do not include the missile program's pro rata share of the multi-purpose items such as aircraft, and naval vessels which are in fact intrinsic parts of the weapons systems.

Production Rates and Operational Stockpile

5. The Operational Stockpile for each of the twenty-one missile systems in the Assumed Program was based upon the summary of numbers a and systems criteria proposed by the Ad Hoc Nuclear Delivery and Air Defense Working Groups. The total missile production required to meet each of these assumed Soviet stockpile objectives, was derived by including not only the stockpile numbers but also by accounting for additional missile requirements such as pipeline, training, maintenance, and other logistic attrition. The systems were scheduled with peak rates and time at peak production reflecting the most economic programming and the cost effectiveness of the weapons system relative to successor programs and requirement time. The date of initiation of production of operational missiles, in all cases, was selected as the mid-point of the year or years given in NIE 11-5-58 as the probable first operational capability date. Allowances for build-up and lead times consistent with U.S. industrial experience were used throughout the program. Unit activation and deployment occurred as the missiles and system elements became available.

Selection of Costs

6. The costs of the assumed program were calculated in 1957 dollars in order to illustrate, in convenient terms, the general magnitude and composition of the program. The dollar costs assigned each system were derived generally by adjusting available cost data for U.S. systems with similar characteristics to those estimated for the Soviet program

in NIE 11-5-58. The techniques and methods used in the cost analysis are those well established in U.S. military weapons systems cost analysis practice, and although average unit costs were used throughout, for convenience, the unit costs selected took into account the reduction in costs which occur as the volume of production increases.

APPENDIX A

STATISTICAL TABLES

TABLE I-A

Number of Guided Missiles In Operational Stockpile, by Year, 1954-1963
(Numbers of Missiles, Cumulative at end of Year)

NIE 11-5-58 Designation	Stockpile Objective	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Surface-to-Surface-Ballistic											
SS-1 (100 n.m.)	3,000	100	200	450	850	1,250	2,000	2,750	3,000	3,000	3,000
SS-2 (200 n.m.)	1,500	40	150	300	450	600	1,050	1,500	1,500	1,500	1,500
SS-3 (350 n.m.)	750	30	100	150	200	250	450	650	750	750	750
SS-4 (700 n.m.)	350			10	30	70	190	310	350	350	350
SS-5 (1,100 n.m.)	350					10	80	190	300	350	350
SS-6 (ICBM)	800						20	260	630	800	800
Surface-to-Surface-Naval											
SS-7 (200 n.m. Sub)	240			4	10	20	60	140	240	240	240
SS-8 (100 n.m. Sub)	200									20	90
Air-to-Surface											
AS-1 (55 n.m.)	300				75	200	300	300	300	300	300
AS-2 (100 n.m.)	200								65	200	200
Air-to-Air											
AA-1	3,800			1,000	2,900	3,800	3,800	3,600	1,600		
AA-2	3,800			1,000	2,900	3,800	3,800	3,600	1,600		
AA-3	23,500					2,900	13,100	23,500	23,500	17,600	5,600
AA-4 (A & B)	24,000							1,400	8,500	18,400	24,000
AA-4 (C)	10,000										2,000

Number of Guided Missiles In Operational Stockpile, by Year, 1954-1963
(Numbers of Missiles, Cumulative at end of Year)
(Continued)

NIE 11-5-58 Designation	Stockpile Objective	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Surface-to-Air-Ground Launched											
SA-1 (Moscow Sites)	13,400	2,640	7,900	13,400	12,900	8,600	2,600				
SA-2 (Moscow Sites)	13,400				500	4,800	10,800	13,400	13,400	13,400	13,400
(All Other)	23,000				130	2,200	5,400	10,000	18,000	23,000	23,000
SA-3	77,000							10,000	36,000	63,000	77,000
SA-4	14,000							3,000	10,000	14,000	14,000
Surface-to-Air-Naval Launched											
SA-6 (Naval)	500						200	500	500	500	500
SA-7 (Naval)	1,300								200	800	1,300

Number of Operational Units Deployed and Equipped
with Missiles, by Year, 1954-1963
(Number of Units, Cumulative at end of Year)

NIE 11-5-58 Designation	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Surface-to-Surface-Ballistic										
SS-1 (100 n.m.)	1	4	9	17	25	40	55	60	60	60
SS-2 (200 n.m.)	1	3	6	9	12	21	30	30	30	30
SS-3 (350 n.m.)	1	2	3	4	5	9	13	15	15	15
SS-4 (700 n.m.)			1	3	7	19	31	35	35	35
SS-5 (1,100 n.m.)					2	11	23	32	35	35
SS-6 (ICBM)						3	33	70	80	80
Surface-to-Surface-Naval										
SS-7 (200 n.m. Sub)			1	2	4	10	25	40	40	40
SS-8 (1,000 n.m. Sub)									1	5
Air-to-Surface										
AS-1 (55 n.m.)				15	45	60	60	60	60	60
AS-2 (100 n.m.)								13	40	40
Air-to-Air										
AA-1			120	360	480	480	450	200		
AA-2			120	360	480	480	450	200		
AA-3					361	1,639	2,943	2,943	2,206	700
AA-4 (A & B)							176	1,059	2,194	3,000
AA-4 (C)										800

Number of Operational Units Deployed and Equipped
with Missiles, by Year, 1954-1963
(Number of Units, Cumulative at end of Year)
(Continued)

NIE 11-5-58 Designation	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Surface-to-Air-Ground Launched										
SA-1	11	33	56	56	56	56	56	56	56	56
SA-2				1	17	41	88	127	175	175
SA-3							20	71	123	150
SA-4								25	75	100
SA-5 (Anti-ICBM)*										
Surface-to-Air-Naval Launched										
SA-6										
Destroyers						1	4	4	4	4
Cruisers						1	2	2	2	2
SA-7										
Destroyers								2	7	13
Cruisers								1	3	4

* Not available in the time period.

Summary of Defensive Missile Production and Units
Deployed by Missile and Year, 1954-1963

NIE 11-5-58 Designation		Monthly Missile Production At Peak Rate	No. of Mos. At Peak Rate	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	Totals
AA-1	Missiles Produced	1,680	18			1,680	3,360	1,680						6,720
	Aircraft Deployed					120	240	120						480
AA-2	Missiles Produced	1,680	18			1,680	3,360	1,680						6,720
	Aircraft Deployed					120	240	120						480
AA-3	Missiles Produced	1,150	18					3,690	13,840	13,744				31,274
	Aircraft Deployed							361	1,278	1,304				2,943
AA-4 (A & B)	Missiles Produced	1,325	25							2,464	10,362	15,890	9,800	38,516
	Aircraft Deployed									176	883	1,135	806	3,000
AA-4 (C)	Missiles Produced	NA*	NA*										2,000	NA*
	Aircraft Deployed												800	NA
SA-1	Missiles Produced	1,736	24	3,472	6,944	6,944								17,360
	Units Deployed			11	22	23								56
SA-2	Missiles Produced**	5,372	45				1,074	8,326	10,743	10,743	10,742	5,372		47,000
	Units Deployed						1	16	24	47	39	48		175
SA-3	Missiles Produced	8,548	27							13,677	33,337	34,193	17,097	98,304
	Units Deployed									20	51	52	27	150
SA-4	Missiles Produced	725	18								4,352	8,704	4,352	17,408
	Units Deployed										25	50	25	100
SA-6 (Naval)	Missiles Produced	25-30	12						250	350				600
	Destroyers Deployed								1	3				4
	Cruisers Deployed								1	1				2
SA-7 (Naval)	Missiles Produced	50	24								300	600	600	1,500
	Destroyers Deployed										2	5	6	13
	Cruisers Deployed										1	2	1	4

* Based on availability 6 months production of buildup. Aircraft production schedule indeterminate.

** SA-2 missile production includes 17,300 missiles for reequipping of Moscow sites.

Summary of Offensive Missile Production and Units
Deployed by Missile and Year, 1954-1963

NIE 11-5-58 Designation		Monthly Missile Production At Peak Rate	No. of Mos. At Peak Rate	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	Totals
SS-1 (100 n.m.)	Missiles Produced	75	42	112	288	400	500	500	700	700	400			3,600
	Units Deployed			1	3	5	8	8	15*	15	5			60
SS-2 (200 n.m.)	Missiles Produced	33	48	50	150	200	200	200	500*	500				1,800
	Units Deployed			1	2	3	3	3	9	9				30
SS-3 (350 n.m.)	Missiles Produced	31	36	32	68	75	75	75	225	225	125			900
	Units Deployed			1	1	1	1	1	4*	4	2			15
SS-4 (700 n.m.)	Missiles Produced	11	33			12	35	70	130	130	60			437
	Units Deployed					1	2	4	12*	12	4			35
SS-5 (1,100 n.m.)	Missiles Produced	11	33					24	105	132	121	55		437
	Units Deployed							2	9*	12	9	3		35
SS-6 (ICBM)	Missiles Produced	36	23						50	360	396	161		967
	Units Deployed								3	30	37	10*		80
SS-7 (200 n.m. Sub.)	Missiles Produced	10	42			10	10	25	75	190	190			500
	Converted Submarines					1	1	1	3	7	7			20
	New Submarines							1	3	8	8			20
SS-8 (1,000 n.m. Sub.)	Missiles Produced	6-7	12**									30	80	110**
	Submarines Deployed											1	4	5**
AS-1 (55 n.m.)	Missiles Produced	17	18				100	200	100					400
	Aircraft Deployed						15	30	15					60
AS-2 (100 n.m.)	Missiles Produced	17	12								100	200		300
	Aircraft Deployed										13	27		40

* Change from radar track/radio command to all-inertial system.

** Based on 10 submarine (nuclear) program completed in 1964. 24 months at peak rate.

TABLE V-A

Yearly Costs of Assumed Program 1954-1963
(Billions of 1957 Dollars)

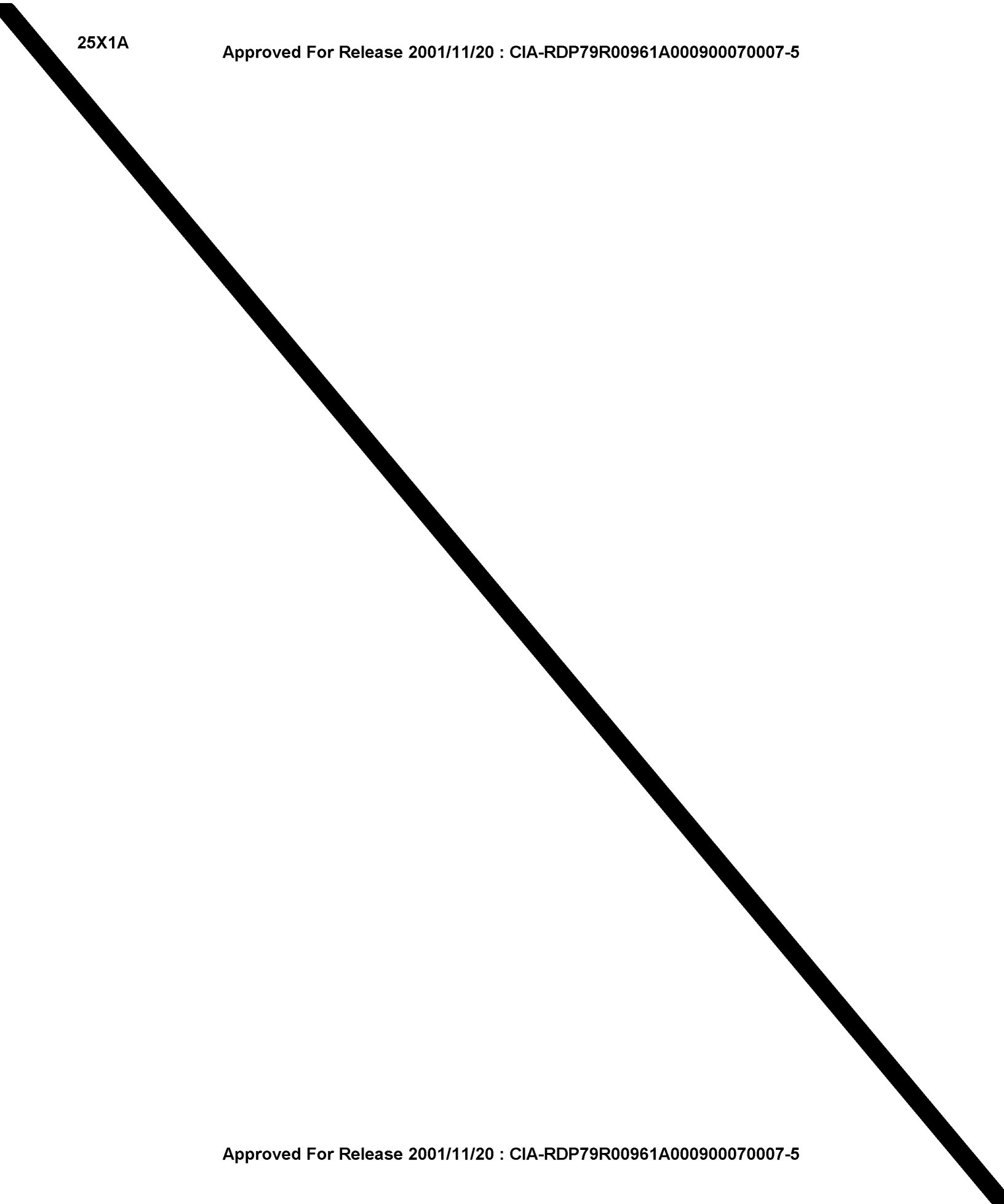
	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	Total
Initial Investment	.4	.7	.9	.5	1.5	4.6	7.4	6.9	5.4	2.9	31.2
Annual Operating		.1	.2	.4	.6	.9	1.8	3.6	5.4	6.3	19.3
TOTAL	.4	.8	1.1	.9	2.1	5.5	9.2	10.5	10.8	9.2	50.5

TABLE VI-A

Total Investment and Operating Costs of
Assumed Program by, Missile System

NIE 11-5-58 Designation	Investment Costs		Operating Costs		Total Costs	
	Billions 1957 Dollars	Percent of Total	Billions 1957 Dollars	Percent of Total	Billions 1957 Dollars	Percent of Total
SS-1	1.1	3.5	0.8	4.1	1.9	3.7
SS-2	0.7	2.2	0.6	3.1	1.3	2.7
SS-3	0.4	1.3	0.7	3.6	1.1	2.2
SS-4	1.5	4.8	2.5	13.0	4.0	7.9
SS-5	1.9	6.1	1.6	8.4	3.5	6.9
SS-6	7.9	25.3	4.3	22.3	12.2	24.2
SS-7	0.9	2.9	0.1	0.5	1.0	2.0
SS-8	0.6	1.9	0.1	0.5	0.7	1.4
AS-1	0.1	0.3	0.2	1.0	0.3	0.6
AS-2	0.1	0.3	*	--	0.1	0.2
AA-1	0.2	0.6	0.1	0.5	0.3	0.6
AA-2	*	--	0.1	0.5	0.1	0.2
AA-3	1.1	3.5	1.4	7.3	2.5	4.9
AA-4 (A & B)	1.0	3.2	0.1	0.5	1.1	2.2
AA-4 (C)	0.2	0.6	*	--	0.2	0.4
SA-1	1.4	4.4	2.6	13.5	4.0	7.9
SA-2	2.6	8.3	1.8	9.3	4.4	8.7
SA-3	6.1	19.5	1.5	7.8	7.6	15.0
SA-4	2.2	7.5	0.5	2.6	2.7	5.3
SA-6	0.2	0.6	0.2	1.0	0.4	0.8
SA-7	1.0	3.2	0.1	0.5	1.1	2.2
TOTAL	31.2	100.0	19.3	100.0	50.5	100.0

* Less than 50 million dollars.



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